Reusing Information Management Services for Recommended Decadal Study Missions to Facilitate Aerosol and Cloud Studies

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ABSTRACT

- NASA Earth Sciences Division (ESD) has made great investments in the development and maintenance of data management systems and information technologies, to maximize the use of NASA generated Earth science data.
- With information management system infrastructure in place, mature and operational, very small delta costs are required to fully support data archival, processing, and data support services required by the recommended Decadal Study missions.
- This presentation describes the services and capabilities of the Goddard Space Flight Center (GSFC) Earth Sciences Data and Information Services Center (GES DISC) and the reusability for these future missions.
- The GES DISC has developed a series of modular, reusable data management components currently in use. They include data archive and distribution (Simple, Scalable, Script-based, Science [S4] Product Archive aka S4PA), data processing (S4 Processor for Measurements aka S4PM), data search (Mirador), data browse, visualization, and analysis (Giovanni), and data mining services.
- Information management system components are based on atmospheric scientist inputs.
- Large development and maintenance cost savings can be realized through their reuse in future missions.

'DECADAL STUDY' RECOMMENDATIONS

The National Research Council's Committee on Earth Science and Applications from Space vision includes "a decadal program of Earth science research and applications in support of society—a vision that includes advances in fundamental understanding of the Earth system and increased application of this understanding to serve the nation and the people of the world." - The committee made several key recommendations regarding research strategies, missions, and measurements.

- In addition, the committee addressed information management with the following recommendations:

- As new Earth observation missions are developed, early attention should be given to developing the requisite data processing and distribution system, and data archive. Distribution of data should be free or at low cost to users, and provided in an easily accessible manner.

- A formal interagency planning and review process should be put into place that focuses on effectively implementing the recommendations made in the present decadal survey report and sustaining and building an Earth knowledge and information system for the next decade and beyond.

(Earth Science and Applications from Space: National Imperatives for the Next Decade and Beyond, NRC, 2007)

Tools and Services for Science Data and Information Management at the GES DISC

Interface with User Community

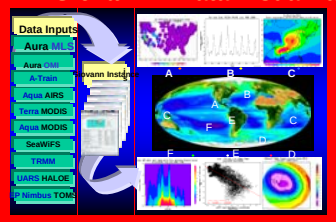
Interface with Science Investigators / Partners

Data Mining

Data mining services available in S4PM
- Users submit and execute data mining algorithms
- Simple Web interface
- Subscriptions process new data as they arrive
- Mining results are made available to user via FTP

Coming Soon: Mining Web Services
- ADaM mining algorithms from Univ. Alabama-Huntsville
- Invoked via Web Services interface

Giovanni: Data Visualization and Analysis



- Data from multiple sensors
- Single- and multi-parameter statistics
- Multiple output formats and protocols
  - JPEG and PNG
  - WMS
  - HDF
  - netCDF
  - ASCII
  - KML for Google Earth
- Multiple input formats & protocols
  - HDF4 and HDF5
  - OPeNDAP
  - WCS
  - Web Services
  - Standard FTP
- Data lineage support

http://giovanni.gsfc.nasa.gov

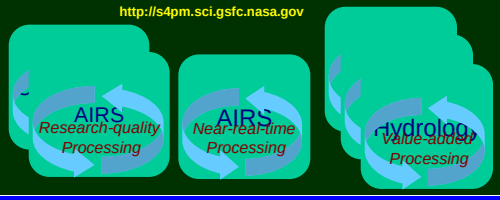
Data & Information Web Portals

Community and project based portals
Accessible from http://disc.gsfc.nasa.gov
Tailored to the users being served
- Multi-mission science research
- Discipline specific portals
- Remote data access

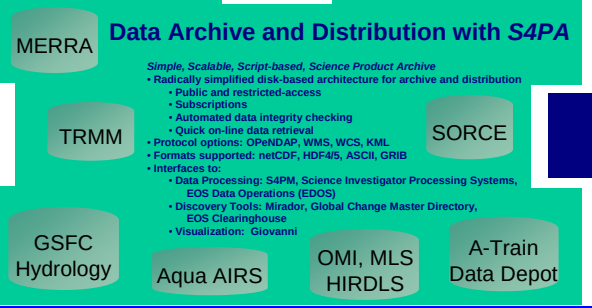
Data Processing with *S4PM*

Simple, Scalable, Script-based Science Processor for Measurements
- Open-source software operational at the GES DISC since 2002
- Near-real-time processing: AIRS, MLS/Aura
- Reused by LaRC for CALIPSO,FlashFlux,MISR; EDC for ASTER On-Demand

http://s4pm.sci.gsfc.nasa.gov



Data Archive and Distribution with *S4PA*



Simple, Scalable, Script-based, Science Product Archive
- Radically simplified disk-based architecture for archive and distribution
  - Public and restricted-access
  - Subscriptions
  - Automated data integrity checking
  - Quick on-line data retrieval
- Protocol options: OPeNDAP, WMS, WCS, KML
- Formats supported: netCDF, HDF4/5, ASCII, GRIB
- Interfaces to:
  - Data Processing: S4PM, Science Investigator Processing Systems, EOS Data Operations (EDOS)
  - Discovery Tools: Mirador, Global Change Master Directory, EOS Clearinghouse
  - Visualization: Giovanni

Mirador Data Search

http://mirador.gsfc.nasa.gov
- Based on Google
- Fast, easy to use
- Gazetteers for places and events
- Can support portals

Interface with Science Teams

Interface with User Community

USING INFORMATION MANAGEMENT SERVICES THAT FACILITATE AEROSOL AND CLOUD STUDIES

Atmospheric Science data sets being served by GES DISC Tools and Services include:

Atmospheric Infrared Sounder (AIRS) - clouds, humidity, water vapor, CO, ozone
High Resolution Dynamics Limb Sounder (HIRDLS) - water vapor, chemistry, aerosols
Limb Infrared Monitor of the Stratosphere (LIMS) - chemistry mixing ratios
Modern Era Retrospective-analysis for Research and Applications (MERRA) - atmospheric model
Microwave Limb Sounder (MLS) - chemistry, water vapor, cirrus ice, relative humidity
Ozone Monitoring Instrument (OMI) - chemistry, aerosol, clouds
Solar Radiation and Climate Experiment (SORCE) - solar irradiance
Total Ozone Mapping Spectrometer (TOMS) - ozone **TIROS Operational Vertical Sounder (TOVS)** - humidity profiles, total ozone, clouds, radiation
Tropical Rainfall Measuring Mission (TRMM) - precipitation
Upper Atmosphere Research Satellite (UARS) - trace gases, temperature, aerosols
Northern Eurasia Earth Science Partnership Initiative (NEESPI) (AIRS, MODIS) - aerosol, clouds
A-Train subsetted data (AIRS, OMI, MLS, Cloudsat, CALIPSO, MODIS, POLDER) - chemistry, clouds
Air Quality Giovanni - PM2.5, MODIS

Other Data Tools and Services

- OPeNDAP
- NetCDF Conversion
- On-the-fly subsetting
- OGC Web Map Server
- Read software for Aura, TOMS,TRMM, UARS
- READ_HDF and READ_H5

REUSING SERVICES FOR RECOMMENDED DECADAL STUDY MISSIONS

Recommended Decadal Study Atmospheric data sets include:

Active Sensing of CO2 Emissions Over Nights, Days, and Seasons (ASCENDS) - carbon dioxide
Aerosol-Cloud-Ecosystems (ACE) - aerosols, clouds
Climate Absolute, Radiance and Refractivity Observatory (CLARREO) - solar irradiance, water vapor
Geostationary Coastal and Air Pollution Events (GEO-CAPE) - chemistry, aerosol
Global Atmospheric Composition Mission (GACM) - chemistry, aerosol
Precipitation and All-Weather Temperature and Humidity (PATH) - precipitation, water vapor, clouds
Three-Dimensional Tropospheric Winds From Space-Based Lidar (3D-WINDS) - wind, atmospheric composition transport